54. (New) The device of claim 52, wherein the semiconductive silicon layer is a semiconductive crystalline silicon layer.

55. (New) The device of claim 53, wherein the gate oxide layer comprises silicon dioxide.

56. (New) The device of claim 55, wherein said subjecting is for a period of at least one hour.

57. (New) The device of claim 49, wherein said subjecting step is conducted so as to provide to said transistor a practical lifetime at least about ten times that provided by a corresponding subjecting step with a hydrogen-enriched ambient rather than the deuterium-enriched ambient, wherein practical lifetime is taken as 20% transconductance degradation as a result of electrical stress.

58. (New) The device of claim 50, wherein said subjecting step is conducted so as to provide to said transistor a practical lifetime at least about ten times that provided by a corresponding subjecting step with a hydrogen-enriched ambient rather than the deuterium-enriched ambient, wherein practical lifetime is taken as 20% transconductance degradation as a result of electrical stress.

59. (New) The device of claim 58, wherein the gate oxide layer comprises ~~silicon dioxide~~.

REMARKS

Entry of the above amendments and reconsideration of this application as amended are respectfully requested. Upon entry of the amendments, this

application will contain claims 40-59, all of which are new claims. Claims 15-20, 23-25, 27 and 36 as prior pending stand rejected under 35 U.S.C. § 102(b) "as being anticipated by Yamazaki (U.S. 4,239,554)". Claims 15-17 as prior pending stand rejected under 35 U.S.C. § 102(b) "as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Van Den Beemt (U.S. 4,542,512). Claims 15-27 and 36-39 as prior pending are rejected under 35 U.S.C. § 103(a) "as being unpatentable over Levinstein et al. (U.S. 4,151,007) in view of Brown et al. (U.S. 4,962,065)".

It is believed that the above-made amendments to the claims render each of these rejections moot. In addition, for the reasons that follow, it is submitted that the maintenance of any of these rejections against the claims as amended would be in error. Reconsideration and withdrawal of all rejections and allowance of this application are therefore solicited.

As a preliminary matter, it is noted that the new claims number 20 total, with two independent. It is thus believed that no claim fees are due. In addition, the new claims find support in the specification and introduce no new subject matter. Briefly, the majority of the elements recited correspond to elements appearing in the original claim set. As to newly-recited claim features, the post-fabrication aspect of the claims (claims 1 and 49) is supported and taught at page 11, line 24 through page 12, line 4. The practical lifetime improvements recited in the claims (1, 57 and 58) are supported at page 17, lines 26+. The 0.1% to 100% deuterium range (claim 45) is supported at page 12, line 19. The

covalent bonding of deuterium at the interface (claims 46, 48 and 49) is supported at page 11, lines 23-24. The duration of at least one hour (claims 43 and 47) is supported at page 24, lines 21-26. The recitation of various device component structures such as source, drain, channel, etc. (claims 48 and 49) is supported in Figure 1 and in the descriptions spanning pages 10 and 11. The remainder of the elements in the new claims correspond to elements appearing in the original claim set. For these reasons, it is submitted that the new claims introduce no new subject matter.

In response to the requirement for drawings, submitted herewith are new, formal drawings for the case. Their entry is requested.

The prior art rejections made in the Office Action will now be individually discussed in relation to the present claims. In each case below, the discussions make it clear that these rejections should not be maintained against the present claims.

I. Anticipation by Yamazaki (U.S. 4,239,554)

Yamazaki does not anticipate a passivated field effect transistor device as presently claimed, either expressly or inherently. The Office Action cites to Column 3, lines 40-45 of Yamazaki for teaching the potential use of deuterium. However, in Yamazaki, deuterium is mentioned only as one possible dopant for use in doping a semiconductor layer in a photoelectric conversion device. Yamazaki does not anticipate claim 40 or its dependent claims 41-49, which require "a field effect

transistor having an interface between a semiconductive silicon layer and a gate oxide layer, characterized by post-fabrication passivation of said interface in a heated, deuterium gas-enriched atmosphere". Nor does Yamazaki anticipate claim 49 or its dependent claims 50-59, which require a field effect transistor which has been subjected "to a heated, deuterium gas-enriched ambient so as to cause deuterium atoms from said deuterium gas to be covalently bound in the area of said interface and thereby increase the resilience of said field effect transistor to hot electron effects caused by channel electrons entering the gate oxide." As disclosed in the application, these post-fabrication passivated devices have unexpectedly increased resistance to degradation from hot carrier effects during operation. For instance, the specific Examples of the present application demonstrate that a ten-fold or greater improvement is readily achievable compared to a field effect transistor correspondingly passivated with hydrogen! Yamazaki does not teach anything relative to attempting to create a post-fabrication passivated field effect transistor as claimed, much less the surprising lifetime improvements which are available.

For these reasons, withdrawal of the rejection based on Yamazaki is solicited.

II. Anticipation by or obviousness over Van Den Beemt (U.S. 4,542,512)

Van Den Beemt does not anticipate passivated field effect transistor devices as presently claimed, either expressly or inherently. The Office Action cites to Figs. 5 and 6, column 5, lines 50-55 and column 6, lines 43-45 of Van Den Beemt for teaching the use of deuterium. Here, however, Van Den Beemt teaches the potential

implantation of deuterium ions to create an electrically-insulating region (14, Fig. 5) in a semiconductor laser. This in no way anticipates claim 40 or its dependent claims 41-49, which require "a field effect transistor having an interface between a semiconductive silicon layer and a gate oxide layer, characterized by post-fabrication passivation of said interface in a heated, deuterium gas-enriched atmosphere". It also fails to anticipate claim 49 or its dependent claims 50-59, which require a field effect transistor which has been subjected "to a heated, deuterium gas-enriched ambient so as to cause deuterium atoms from said deuterium gas to be covalently bound in the area of said interface and thereby increase the resilience of said field effect transistor to hot electron effects caused by channel electrons entering the gate oxide."

Furthermore, the teachings of Van Den Beemt in no way render such claimed field effect transistors obvious. In particular, the claimed transistors are characterized by post-fabrication passivation in a deuterium-enriched atmosphere. As disclosed in the application, these devices have unexpectedly increased resistance to degradation from hot carrier effects during operation. For instance, the specific Examples of the present application demonstrate that a ten-fold or greater improvement is readily achievable compared to a field effect transistor correspondingly passivated with hydrogen! Such surprising, large improvements have also been acknowledged in subsequent publications. For example, I.P. Ipatova et al., *J. Appl. Phys.* 83(2) (copy attached for convenience), acknowledges the giant increase in transistor lifetime, and discusses potential

explanations for the same involving adatom localized vibrations. These large lifetime improvements are in fact much greater than might have been surmised from prior-discussed differences between hydrogen and deuterium such as different zero-point energy levels and kinetic isotope effects [see e.g. WO 94/19829, pp. 6-7 (copy attached)] that may have affected their behavior in semiconductor devices Accordingly, it is submitted that both the results presented in the application and the art support the patentability of the present claims.

On these bases, it is requested that the anticipation and obviousness rejections based on Van Den Beemt be withdrawn.

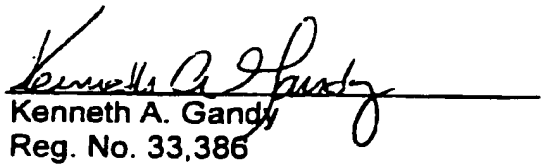
III. Obviousness over Levinstein et al. (U.S. 4,151,007) in view of Brown et al. (U.S. 4,962,065)

The combination of Levinstein et al. and Brown et al. does not render obvious passivated field effect transistor devices as presently claimed. The Office Action cites Levinstein et al. as teaching the passivation of a field effect transistor structure by a hydrogen annealing step. Brown et al. is relied upon in the Office Action for teaching minimization of displacement damage by use of deuterium followed by annealing. However, as acknowledged in the Office Action, the passivation described in Levinstein et al. is limited to the use of a hydrogen atmosphere, not a deuterium atmosphere. Moreover, the aspects of Brown et al. relied upon do not even relate to interface passivation, but rather merely disclose that deuterium ion implantation (among other ions) can alter the

chemical bonding in CVD silicon nitride. As a result, it is submitted that the combination of Brown et al. with Levinstein et al. is suspect, and if even so combined that the references do not teach or suggest the claimed post-fabrication passivated transistor devices or their unexpected improvements. As noted above, the claimed transistors are characterized by post-fabrication passivation in a deuterium-enriched atmosphere, and have unexpectedly increased resistance to degradation from hot carrier effects during operation. This is both demonstrated in the application's working Examples and evidenced by publications in the art. Withdrawal of the obviousness rejection based on Levinstein et al. in view of Brown et al. is therefore also solicited.

In view of the foregoing amendments and remarks, it is submitted that this application is in condition for allowance containing claims 40-59. Action to that end is solicited.

Respectfully submitted,

By 

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